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Photovoltaic Effect in Organic Polymer-Iodine Complex

It has been found that certain charge transfer complexes formed from organic polymers and iodine generate appreciable voltages at relatively low impedances upon exposure to light. For example, poly-N-vinylcarbazole (PVCA) films complexed with iodine give sizable photovoltages (the Dember effect) with an output impedance (approximately 2 megohms) much lower than that of organic semiconductors such as anthracene (approximately 10^8 megohms), which also exhibit the Dember effect.

Films were cast by evaporation of a dichloromethane solution of purified PVCA. Iodine complexing was accomplished by exposing the films to the vapors from solid iodine in a sealed container at room temperature. In this manner, PVCA-iodine films containing 5 to 30 percent iodine by weight were obtained. Photovoltaic cells were made by sandwiching the films between two transparent glass slides made conductive with a coating of tin oxide.

With cells containing 0.003-inch-thick films of the PVCA-iodine complex (30 percent iodine) light intensities of approximately 20 mw/sq cm produced absolute photovoltages of 5 to 15 mv. The voltage obtained varied both with the intensity and wavelength of the light source. With incident white light, the photovoltage varied almost linearly with intensity below 140 mw/sq cm and with the square root of intensity above this value. Other organic systems, for example, anthracene, show a much weaker dependence of the Dember voltage on light intensity.

Notes:

1. These films show promise in applications requiring chemically and electrically stable films as detectors of optical radiation and as energy converters in photovoltaic cells. The films are believed to be more resistant to cosmic radiation damage than inorganic polycrystalline films and should be less expensive to produce.
2. Additional details are given in *Photovoltaic Effect in Poly-N-Vinylcarbazole-Iodine Charge Transfer Complex*, by A. M. Hermann and A. Rembaum, JPL Space Programs Summary 37-43, Vol. IV, p. 196-201. Tech Brief 66-10682 describes the preparation and use of this type of charge transfer complex in primary cells, and Tech Brief 67-10132 suggests the use of PVCA-iodine complexes as electrically conductive plastics to minimize the hazards of static electricity buildup. Inquiries may also be directed to:

Technology Utilization Officer
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Reference: B67-10634

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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